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The Cryosphere Discussions

Interactive comment on "Sensitivity of a distributed temperature-radiation index melt model based on a four melt season AWS record from Hurd Peninsula glaciers, Livingston Island, Antarctica" *by* U. Y. Jonsell et al.

Anonymous Referee #2

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This paper makes an important contribution to a better understanding of energy exchange and sensitivity of the ice masses on the Antarctic Peninsula and surrounding islands. The region has only very limited coverage of glaciological reference measurements, in particular data sets spanning consistently over several years although it is a region showing considerable climatic changes and impacts on the cryosphere in the last decades. The authors do not only present new measurements and modelling results, they also provide a refined methodology to handle diurnal albedo variations. The paper is well-written and clear, it contains considerable new aspects and information

and hence is suitable for publication in The Cryosphere. I recommend this paper for publication with some revisions as listed below.

Considering that a main part of the paper is dealing with point surface energy balance computations and respective fluxes, the title of the paper might be adapted to better represent this. Perhaps the authors might want drop the statement that they cover 4 melt seasons and mention that they also provide flux computations at a single point.

Specific comments:

3222-20: Change the order from general to specific – first changes in meteorological conditions and then air temperature changes

3223-29/3244-1: This statement is very broad and the reference cited address different processes. I am not sure if this was intended. Pritchard & Vaughan (2007) relate the speed-up of glaciers to dynamic thinning of the glacier tongues. Rott et al. (1996), Rignot et al. (2004), Scambos et al. (2004) are all relevant paper for the region, however they address the break-up of ice shelves in the region and the subsequent surges and surface lowering of the glaciers. Hence, the general link of warming to changes in glacier dynamics is a kind of a shortcut without mentioning the different underlying processes/theories, e.g. more melt, formation of melt ponds, draining into crevasses, widening, break-up. It might also be understood under this statement that warming causes more melt water lubricating the bed, however there is to my knowledge no proof of this for the region so far.

3224-3: The observed glacier retreat of tidewater glaciers might not only be linked to warming

3230-24: As the selection of roughness lengths have quite some impact on the computed fluxes it would be nice to give the final values or outline the methodology of Andreas (1987) at this point.

3233-22: "mass balance“ - surface mass balance, please adhere to the new UNESCO-

IACS glossary with your terminology throughout the document.

3234 temp. index model: Please provide the parameter values for the threshold temperature for snow-ice transition for precipitation as well as the lapse rates (air temperature, precipitation) if applied.

3234-22: Its is correctly mention that different parameters sets can lead to comparable model fits. What criteria were used to select the best parameter set and how different were the results of other model runs? It would be helpful to have a table of all model parameter settings rather then statements spread over the text.

3236: Please elaborate more on the annual variability of melt rates and surface mass balance. The observed time period include to my knowledge partly very cold winter temperatures and high precipitation rates. In Tab. 2 and Fig. 6 quite some interannual variability seems to be captured but not well addressed in the text and might be partly whipped out by averaging. Rückamp et al (2011) also show 100% difference in net accumulation values for this observation period from adjacent King George Island. Can similar patterns be identified and if so can those variations be attributed to different circulation patterns, e.g. as shown by Braun et al. (2001)?

3237-1: Please stick to one unit either give the values in 'm w.e.' or 'mm w.e.' as in the table

3238-1: Since there seems to be a strong temperature threshold effect, it might be worth giving the parameter value for the snow-rain transition in the model. This is also relevant for the sensitivity analysis.

3236-1: This works make significant new contributions to energy balance computations and mass balance in the region. However, it would be important to discuss the presented results more in the context of the few observations and modelling attempts in the region, most often only over considerably shorter time periods (e.g. Jamieson & Wager, 1983; Bintanja, 1995; Schneider, 1999; Braun et al., 2001, Braun et al., 2004).

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3236-20: Braun & Hock (2004) found that their measured lapse rates during melt situations were below the frequently used climatic lapse rate. Are there similar observations or choices of parameters? How sensitive is the calibrated model against changes in lapse rate?

3247: Tab. 2: rearrange so that first fluxes are shown and then the resulting modelled melt, then comparison to measurements.

3255: increase size and readability

References:

UNESCO-IHP-IACS (2011): Glossary of glacier mass balance and related terms. IHP-VII Technical Documents in Hydrology No. 86, IACS Contribution No. 2

Bintanja, R. (1995): The local surface energy balance of the Ecology Glacier, King George Island, Antarctica: measurements and modelling. Antarctic Science 7 (3), 315-325.

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Schneider, C. (1999): Energy balance estimates during the summer season of glaciers of the Antarctic Peninsula. Global and Planetary Change 22(1-4), 117-130.

Braun, M., Saurer, H., Vogt, S., Simoes, J.C. & Goßmann, H. (2001): The influence of large-scale circulation on surface energy balance on the King George Island ice cap. International Journal of Climatology 21 (1), 21-36.

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Jamieson, A.W., Wager, A.C. (1983): Ice, water and energy balances of Spartan Glacier, Alexander Island. Br. Antarct. Surv. Bull. 52, 155–186.

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